TO TRUST, OR NOT TO TRUST:
COGNITIVE REFLECTION IN TRUST GAMES[1]

Abstract: We present results from two studies that show a positive relation between cognitive reflection and trusting behavior, but no significant relation with trustworthy behavior. Our finding holds regardless of individual distributional social preferences and risk aversion. Our results add to a growing body of literature that illustrates the role of cognitive ability in helping explain outcomes in economic experiments.

INTRODUCTION

Trust is essential for the consummation of exchange and subsequent realization of gains (Smith, 1759). Arrow (1972) argued that trust is indispensable for the proper functioning of any economic system: *"Virtually every commercial transaction has within itself an element of trust… It can be plausibly argued that much of the economic backwardness in the world can be explained by the lack of mutual confidence"* (p. 357). Relatedly, trust has been shown to impact economic variables such as growth and financial development (Algan and Cahuc, 2010) as well as entrepreneurship and trade (Guiso, Sapienza and Zingales, 2004, 2006). In sum, trust is seen as the lubricant that facilitates exchange in society so its relevance cannot be overstated.

In this paper, we propose a microeconomic analysis of the determinants of trust. We build on the experimental economics literature that has developed (Berg, Dickhaut and McCabe, 1995) and extensively studied (see meta-analysis by Johnson and Mislin, 2011) incentivized behavioral measures of trust and trustworthiness. Interestingly, there is evidence of a relation between the behavioral measure of trust developed in the lab and macroeconomic variables. For example,

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Johnson and Mislin (2011) found a positive correlation between GDP in a given country and the experimental measure of trust of a sample of its population.

Although a number of personal characteristics ranging from personality traits to education may affect trusting behavior, we focus on the role of cognitive ability. This is motivated by the fact that previous research has reported preliminary evidence of a positive correlation between intelligence and generalized trust (i.e. trust in other members of the society) (Sturgis, Read and Allum, 2010; Hooghe, Marien and de Vroome, 2012; Carl and Billarri, 2014). Generalized trust is a self-reported measure of trust, which is assessed by non-incentivized survey questions such as "How often do you trust others?" Recently, Carl and Billari (2014) have shown that there exists a positive correlation between generalized trust and measures of intelligence in a large, nationally representative sample of U.S. adults. Their measures of intelligence were both objective and subjective: subjects were evaluated on the basis of exactly how they responded to a verbal test, or the perception of an interviewer regarding how well they understood the questions asked. We extend this research by studying a behavioral measure of trust that was elicited in a controlled and incentivized environment. In addition, we consider whether a validated and widely used measure of cognitive ability: the Cognitive Reflection Test (CRT) can explain trust or trustworthiness behavior in our particular experiment.

Our work also contributes to the growing body of research on the relation between cognitive abilities and economic behavior in the experimental economics literature. A large number of experimental studies have used the CRT (Frederick, 2005) both because of its short duration and its unprecedented success in predicting economic decisions (e.g. Oechssler, Roider, and Schmitz, 2009). For example, student performance in the CRT has been shown to correlate positively with earnings in experimental asset markets (Corgnet, Hernán-González, Kujal and Porter, 2015) and other individual tasks and games involving risk and time preferences (Frederick, 2005; Oechssler, Roider, and Schmitz, 2009; Brañas-Garza, García-Muñoz, and Hernán-González, 2012). The CRT has also been shown to be positively correlated with general measures of intelligence such as the SAT (Frederick, 2005).

The CRT may be an especially relevant measure of cognitive ability for the study of strategic economic decisions (e.g. trust) because it simultaneously captures the ability to engage in reflective processes and execute computational tasks measured in standard intelligence tests (e.g. SAT or Raven matrices; Toplak, West and Stanovich, 2011). In the CRT, respondents are given three questions to which there is an intuitive (automatic) yet incorrect answer. However, with a little deliberation (or cognitive reflection) subjects can override the intuitive response and figure out the correct answer.

In this paper we employ two studies to look at the relation between cognitive reflection and trust. In the first part we examine data from a trust study that uses the standard CRT measure. In the second, we use an augmented version of the CRT (Toplak, West and Stanovich, 2014) as well as elicit subjects' distributional social preferences à la Bartling et al. (2009) and risk attitudes (Holt and Laury, 2002). We find a positive relation between scores on both CRT tests and trust, but not a significant relation with trustworthiness. Our results are robust to whether participants play only one role (Study 1) or both (Study 2) and also whether the game is implemented as a direct-response (Study 1) or strategy method (Study 2). Finally, these results hold when controlling for social preferences and risk aversion (Study 2).

Study 1: A first look at the relation between CRT, Trust and Trustworthiness

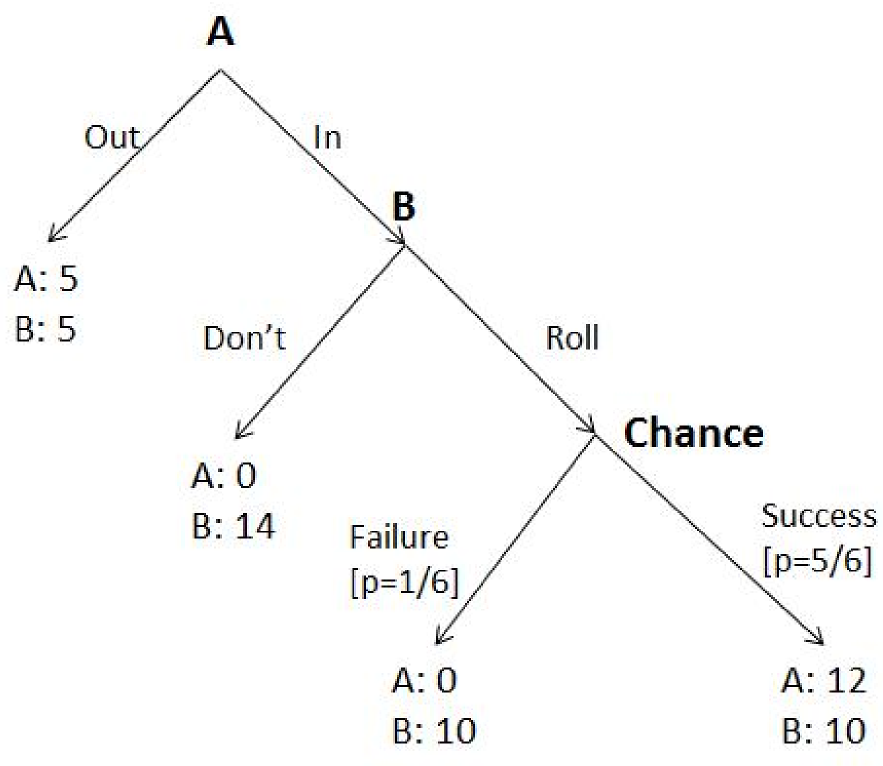
Methods

As part of a project studying communication and trust, we recruited 80 subjects (52.50% female) to participate in a baseline treatment. We conducted a total of 6 independent sessions with either 12 or 14 subjects in each session. Subjects were recruited from a database of more than 2,000 students attending a major U.S. university. A subset of the whole database received invitations at random for participating in the current study. The experiment lasted for one hour and subjects earned an average of $14.25 including a $7 show-up fee.

Measurement of trust. In this study, we use the game of trust described in Charness and Dufwenberg (2006; 2010). In the first stage of the game, player A decides whether to play *In* or *Out*. If player A chooses *Out* then the game is over and each player earns $5. If player A chooses *In* then player B has to select either *Don't* or *Roll*. If player B chooses *Don't* then player B gets $14 whereas player A gets nothing. If player B chooses Roll, then the roll of a six-sided die decides whether the final outcome of the game is a success or a failure. If it is a success (which occurs with probability 5/6) player A gets $12 and player B gets $10, and if it is a failure player A gets nothing while player B gets $10. The payoffs of the game are described in Figure 1. This game can be seen as a game of trust à la Berg et al. (1995) where player A is the trustor and player B is the trustee. The decision for player A to trust thus corresponds to choosing *In* and the decision for player B to be trustworthy corresponds to choosing *Roll*. This game slightly differs from the standard trust game because of the role of chance. As a result, if player A gets zero payoff in this game (s)he does not know whether this is due to player B choosing *Don't* roll the die or if it is due to bad luck in the *Roll*.

Upon arrival, subjects were randomly assigned to one of two separate rooms. All subjects in each room were assigned the same role (e.g. Player A) and were informed that they would be matched with a player in another room playing a different role (e.g. Player B). In contrast to Charness and Dufwenberg (2006; 2010), the game was not played using a strategy-method procedure. Instead, subjects in the role of player B were asked to *Roll* or *Don't roll* only if player A, who they had been matched with, had chosen *In*.

Figure 1- The Charness-Dufwenberg (2006; 2010) Trust Game



Measurement of cognitive reflection. In addition to playing the trust game, we asked subjects to complete the CRT. We list the CRT questions below:

(1) A bat and a ball cost $1.10 in total. The bat costs a dollar more than the ball. How much does the ball cost? ____ cents [Correct answer: 5 cents; intuitive answer: 10 cents]

(2) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? ____ minutes [Correct answer: 5 minutes; intuitive answer: 100 minutes]

(3) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? ____ days [Correct answer: 47 days; intuitive answer: 24 days]

Our measure of cognitive reflection is given by the total number of correct answers (*mean* $\pm SEM = 1.52 \pm 0.18$ for females, 1.95 ± 0.19 for males; Mann-Whitney-Wilcoxon test, $p = 0.102$). As is standard practice, the cognitive reflection test was not incentivized (Frederick, 2005; Brañas et al. 2015).

Results

The distribution of CRT scores along with the relative frequency of trust (*In*) and trustworthy choices (*Roll*) is displayed in Table 1.

TABLE 1: Frequency of Trust and Trustworthiness decision by CRT scores

CRT	Trust *(In)* [n=40]	Trustworthiness *(Roll)* [n=27][+]
0	57% [n=7]	25% [n=8]
1	50% [n=12]	40% [n=5]
2	67% [n=6]	40% [n=5]
3	87% [n=15]	55% [n=9]

[+]Since 67% (27 out of 40) of A players chose *In*, only 27 B players made a decision.

In Table 2 we report the regression analysis of the *Trust* decision (coded as a dummy that takes value 1 if Player A chose *In* and 0 otherwise) on CRT scores and gender using a probit regression with robust standard errors (regressions [1] and [2]). We obtain a positive and significant relation between CRT scores and trust. This relation holds, whether we control for gender (*p-value=0.061, column [2]*) or not (*p-value=0.054, column [1]*). Although trustworthiness also increases with CRT scores (Table 1), the same analysis for the *Trustworthiness* decision (coded as a dummy that takes value 1 if Player B chose *Roll* and value 0 otherwise) does not result in a significant CRT coefficient (*p-value=0.215 and p-value=0.214 in columns [3] and [4]*).

TABLE 2. Probit regression for Trust and Trustworthiness

	Trust		Trustworthiness	
	[1]	[2]	[3]	[4]
Intercept	-0.13	-0.03	-0.64	-0.51
	(0.37)	(0.47)	(0.41)	(0.51)
CRT	0.36*	0.35*	0.25	0.26
	(0.19)	(0.19)	(0.20)	(0.21)
Female		-0.13		-0.22
		(0.43)		(0.51)
No. of observations	n = 40	n = 40	n = 27	n = 27
Pseudo-R^2	0.07	0.08	0.04	0.05
Wald-χ^2	3.70*	3.68	1.57	1.75

Female is a dummy variable that takes value 1 if subject is female and zero otherwise.
Estimation output using robust standard errors (in parentheses).
*p-value<.10, **p-value<.05, and ***p-value<.01

Given the limited number of observations in this first study, we take this finding as only suggestive of an effect of cognitive ability on trust. The role of chance in the outcome of player B's *Roll* decision may also be influencing the results. We thus designed a second study where we recruited a larger sample of subjects and for which we implemented a "standard" trust game following Berg et al. (1995). We also use Study 2 to collect data on distributional social preferences in order to evaluate whether the CRT effect is driven by its possible relation with social preferences.

Recent research has investigated the relation between social preferences and intelligence (Brandstater and Guth, 2002; Ben-Ner, Kong, and Putterman, 2004; Millet and Dewitte, 2006; Chen, Chiu, Smith and Yamada, 2013). For example, Chen et al. (2013) find a positive relation between subjects' score in the Math section of the Scholastic Aptitude Test (SAT) and 'giving' in a standard dictator game, but a negative relation between their Grade Point Average (GPA) and 'giving'. Closer to our study, distributional social preferences have been recently found to correlate with CRT scores (Corgnet, Espin and Hernan-Gonzalez, 2015; Cueva et al., in press; Ponti and Rodríguez-Lara, 2015). Thus, controlling for subjects' preferences over simple payoff distributions provides an interesting robustness check.

Another possible confounding factor in the relation between trust and CRT is related to people's risk attitudes. Frederick (2005) found that subjects with higher CRT scores were less likely to be risk averse. The trust game, which can be framed as an investment game, involves substantial investment risks related to the uncertainty associated with the behavior of the trustee. The willingness to trust could thus be positively related to CRT scores due to a higher willingness of more reflective individuals to engage in a risky investment. Even though prior evidence regarding the relation between trusting and risky decisions is mixed (Eckel and Wilson, 2004; Fehr, 2009; Houser et al., 2010; Karlan, 2005; Kosfeld et al., 2005), we collected individual risk attitudes measures (à la Holt and Laury, 2002) to be used as controls in our regression analyses.

Study 2: A further inquiry into the relation between CRT, Trust and Trustworthiness

Methods

We recruited 100 subjects (47% female) to participate in the study. We conducted a total of 8 independent sessions with either 12 or 14 subjects in each session. Subjects were recruited from the same database of more than 2,000 students used in Study 1. A subset of the whole database received invitations at random for participating in the current study with the restriction that they had not participated in Study 1. In addition to the trust game, subjects were also asked to complete an extended CRT, a social preferences test and a risk elicitation task. These data were collected in the context of a larger research program on economic and social preferences, cognitive abilities and creativity.

Measurement of trust. We consider a variation of the trust game described in Study 1. First, chance played no role. Second, the game was implemented using the strategy method so that each of the 100 subjects played both the role of trustor and trustee (see for example Eckel and Wilson, 2004 and Casari and Cason, 2009). The strategy method allows us to increase the sample size.

Both the trustor and the trustee were endowed with 100¢. In the role of the trustor, subjects had to decide whether to send their entire 100¢ endowment to the trustee or to keep it. As trustees, subjects had to decide how to split the amount received from the trustor. The amount sent by the trustor (100¢) was tripled (to 300¢) by the experimenter (as in Berg et al., 1995). The different allocations available to the trustee were as follows: {300¢,0¢}; {250¢,50¢}; {200¢,100¢}; {150¢,150¢}; {100¢,200¢}; {50¢,250¢} and {0¢,300¢}. Each subject was randomly assigned to one role and matched with a single partner assigned to the other role to compute payments.

Measurement of cognitive reflection. We extended the CRT described in Study 1 (Frederick, 2005) by adding four questions recently developed by Toplak, West and Stanovich (2014) all of which have been validated as a measure of cognitive reflection ($\alpha = 0.72$). The additional CRT questions are as follows:

(4) If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together? _____ days [correct answer: 4 days; intuitive answer: 9]

(5) Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class? ______ students [correct answer: 29 students; intuitive answer: 30]

(6) A man buys a pig for $60, sells it for $70, buys it back for $80, and sells it finally for $90. How much has he made? _____ dollars [correct answer: $20; intuitive answer: $10]

(7) Simon decided to invest $8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has: a. broken even in the stock market, b. is ahead of where he began, c. has lost money [correct answer: c, because the value at this point is $7,000; intuitive response: b].

Again, this test was not incentivized and males obtained a higher score (*mean* = *4.26±0.29*) than females (*mean = 3.06±0.29*; Mann-Whitney-Wilcoxon test, $p = 0.005$).

Measurement of social preferences. We elicited distributional (also referred to as 'outcome-based', see Fehr and Schmidt, 2006) social preferences by asking participants to make four choices (Bartling et al., 2009). Each choice was between two possible allocations of money for that person and another anonymous participant with whom they were randomly matched (see Table 3). In each choice Option A always provided an even distribution of money ($2 to the self and the other participant), while Option B provided one of four uneven payoffs: ($2, $1), ($3, $1), ($2, $4), and ($3, $5) in Choices 1, 2, 3 and 4, respectively. In Bartling et al. (2009), the four choices are labeled as the 'prosociality', 'costly prosociality', 'envy' and 'costly envy' games, respectively (see the last column of Table 3). In the 'prosociality' game, participants had to decide whether to increase the payoff of a worse-off counterpart at no personal cost. In contrast, increasing the counterpart's payoff was costly for the decision maker in the 'costly prosociality' game. In the 'envy' game, participants could reduce the payoff of a better-off counterpart at no personal cost, whereas it was costly in the 'costly envy' game. Following Bartling et al. (2009), participants who chose the egalitarian allocation (Option A) in both the 'prosociality' and the 'costly prosociality' games are categorized as '*aheadness averse*' (27% in our sample), whereas those who chose the egalitarian allocation in both the 'envy' and the 'costly envy' games are categorized as '*behindness averse*' (23% in our sample). In each experimental session, two subjects, *i* and *j*, were randomly selected for payment. Then, one of the four choices made by participant *i* was randomly chosen and used to allocate the payoffs of both participants, *i* and *j*.

TABLE 3. Social preferences elicitation (Bartling et al. 2009).

Choice	Option A Payoff self, Payoff other	Option B Payoff self, Payoff other	Social Preference 'Game'
1	$2,$2	$2,$1	Prosociality
2	$2,$2	$3,$1	Costly Prosociality
3	$2,$2	$2,$4	Envy
4	$2,$2	$3,$5	Costly Envy

Measurement of risk attitudes. We elicited risk attitudes following Holt and Laury (2002) by asking subjects to make ten binary lottery choices. One lottery (out of 10) was selected at random for each subject and used for payment. We follow Holt and Laury (2002) and use the number of safe choices in the ten binary lottery choices to categorize subjects' risk attitudes. We only report data for the subjects (95 out of 100) who completed the ten binary lottery choices without switching back and forth between the safer and the riskier options.[2]

Results

As can be seen in Table 4, the raw data appear to confirm the results of Study 1 by showing that trust increases along with CRT scores, whereas no clear pattern is observed between CRT scores and trustworthiness. To understand the magnitude of the effect on trust, note that subjects with the highest CRT score trust on average almost *two and a half times* more frequently (90.0%) than subjects with the lowest CRT score (37.5%).

TABLE 4: Trust and Trustworthiness decisions by CRT scores (extended test)

CRT [observations]	Trust *Percentage of subjects sending money*	Trustworthiness *Average amount returned (out of 300)*[*]
0 [8]	38	125
1 [9]	56	78
2 [18]	56	114
3 [11]	64	123
4 [15]	53	137
5 [12]	75	100
6 [17]	77	85
7 [10]	90	95

[*] In the case that the trustor has sent his/her initial endowment.

The positive relation between trust and CRT scores is statistically significant in a probit regression with trust (i.e., a dummy that takes value 1 if the trustor sends his/her endowment, and value 0 otherwise) as the dependent variable (Table 5, regression [1]). Controlling for gender (Female Dummy = 1 if female) does not qualitatively affect the result (regression [2]).

Due to the possible link between trust and risk attitudes, we also controlled for risk aversion in our regression analysis (regressions [3] and [5]). The positive effect of CRT on trust continues to hold. We found no significant relation between risk aversion and trust.[3]

[2] The proportion of inconsistent switching was similar to the proportion reported by Holt and Laury (2002) which varies between 5.5% and 13.2%.

Finally, as mentioned above, recent research has shown that subjects' distributional social preferences are related with their CRT scores (Corgnet et al., 2015a; Cueva et al., in press; Ponti and Rodríguez-Lara, 2015). In particular, Corgnet et al. (2015a) find that individuals with higher CRT scores are more likely to make choices consistent with "mild" altruism and less likely to be driven by either egalitarian or spiteful motives.[4] In order to account for distributional preferences as a potential confound in the relation between trust and CRT, we included dummies for both 'aheadness' and 'behindness' aversion as controls (regressions [4] and [5]).

We find that the effect of CRT on trust cannot be accounted for by distributional preferences. The coefficient associated with CRT remains positive and significant after the inclusion of these controls.[5] In addition, those subjects who display a stronger aversion to advantageous inequality ('ahead averse') are more likely to trust, although this effect is significant only in regression [5] where risk attitudes are controlled.

TABLE 5. Probit regression for TRUST

TRUST	[1]	[2]	[3]	[4]	[5]
Intercept	-0.24	0.05	0.57	0.03	0.68
	(0.25)	(0.33)	(0.59)	(0.35)	(0.60)
CRT	0.17***	0.15**	0.15**	0.14**	0.15**
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)
Female Dummy		-0.42	-0.47*	-0.40	-0.48
		(0.28)	(0.29)	(0.28)	(0.29)
Risk Aversion			-0.08		-0.11
			(0.08)		(0.08)
Ahead Averse Dummy				0.51	0.69**
				(0.32)	(0.34)
Behind Averse Dummy				-0.37	-0.26
				(0.33)	(0.36)
No. of observations	n = 100	n = 100	n = 95	n = 100	n = 95
pseudo R^2	0.06	0.07	0.09	0.11	0.13
Wald-χ^2	7.39***	11.01***	11.93***	13.29***	14.58***

Estimation output using robust standard errors (in parentheses).
*p-value<.10, **p-value<.05, and ***p-value<.01

[3] We do not find a significant relation between CRT and risk aversion either (Pearson rho = 0.04, p = 0.678; Spearman rho = -0.002, p = 0.987).

[4] We find similar results in our sample. These results are available upon request.

[5] The results are robust to different specifications of our measures of distributional preferences. For example, the CRT coefficient is 0.125 (*p=0.063*) when we include four dummy variables, one for each decision in the social preferences task. Also, the CRT coefficient remains significant if we control for each dummy variable separately (all *p*'s < *0.054*).

In line with Study 1, we find that, unlike trust, trustworthiness is not significantly related to cognitive reflection. This is true for all our model specifications (see Table 6).[6] In addition, subjects who are more averse to advantageous inequality tend to return more money to the trustor (regressions [4] and [5]). Finally, more risk averse individuals also exhibit more trustworthiness (regressions [3] and [5]).

TABLE 6. Linear regression for the amount returned TRUSTWORTHINESS

TRUSTWORTHINESS	[1]	[2]	[3]	[4]	[5]
Intercept	118.73***	115.41***	53.56*	105.67***	52.51*
	(14.16)	(15.77)	(28.43)	(17.17)	(30.51)
CRT	-3.04	-2.73	-3.11	-3.11	-3.27
	(3.43)	(3.38)	(3.18)	(3.41)	(3.18)
Female Dummy	-	4.65	5.59	5.64	5.62
		(13.75)	(13.80)	(13.61)	(13.59)
Risk Aversion			10.18***		8.96**
			(3.89)		(4.04)
Ahead Averse Dummy	-	-		43.79***	39.56***
				(13.36)	(13.62)
Behind Averse Dummy	-	-		-4.85	-7.33
				(17.53)	(17.99)
No. of observations	n = 100	n = 100	n = 95	n = 100	n = 95
R^2	0.01	0.01	0.07	0.09	0.13
F	0.78	0.40	2.62*	2.95**	3.63***

Estimation output using robust standard errors (in parentheses).
*p-value<.10, **p-value<.05, and ***p-value<.01

Discussion: Why Would More Reflective People Trust More?

We have shown that cognitive ability is positively related to trust in two experiments where trusting decisions have real monetary consequences, thus supporting previous findings from self-report surveys (Sturgis et al., 2010; Hooghe et al., 2012; Carl and Billarri, 2014). Furthermore, our data indicate that the relation between CRT scores and trust is not mediated by subjects' distributional or risk preferences.

One likely explanation to the current results could be that individuals with higher cognitive skills are more able to correctly guess the distribution of trustees' choices and/or to choose so as to maximize their expected returns given such distribution. Results from Berg et al.

[6] The results are also consistent if we estimate ordered multinomial probit instead of linear regressions, reporting a CRT coefficient of -0.048 (*p = 0.379*), -0.043 (*p = 0.414*), -0.049 (*p* = 0.339), -0.051 (*p = 0.350*), and -0.055 (*p* = 0.291) for regressions [1], [2], [3], [4], and [5], respectively.

(1995) and others would suggest that attaching a reputation to players might even increase the propensity to trust. It is not hard to imagine that the ability to trust is largely beneficial in a society where survival and prosperity crucially hinge upon the capacity to engage in exchanges with counterparts with various degrees of familiarity. All such transactions, as was argued by Adam Smith (1759), require an important element of trust. Indeed, evolutionary psychologists have hypothesized that the capacity to attach a reputation to interaction partners (for which trusting others may be a necessary prerequisite) is a distinctive form of human social intelligence favored by natural selection (e.g. Yamagishi, 2001 and Cosmides, Barrett and Tooby, 2010). In our second study, the decision to trust and send 100¢ to the trustee produced a median (average) return of 150¢ (107.5¢). Trusting led to a significant increase in earnings compared to not trusting ($p = 0.0599$ for the Wilcoxon sign-rank test), supporting such a hypothesis. However, in our first study, trust led to a non-significant decrease in earnings ($5 vs. $4.07; Wilcoxon sign-rank test, $p = 0.652$). Therefore, our results are not completely coherent with an explanation based on the higher ability of high-CRT individuals to maximize their expected returns in the trust game.

An alternative explanation of our findings relates to betrayal aversion. Trusting others involves "social risk" because the returns from trusting depend on another person's decision and not on chance alone (e.g. Bohnet et al., 2008). There is evidence that betrayal aversion leads people to take less risk in situations in which the return on investment is determined by other people's decisions rather than by chance alone (Bohnet and Zeckhauser, 2004; Bohnet, Herrmann and Zeckhauser, 2010; Aimone and Houser, 2012). Since betrayal aversion has an important emotional basis (Aimone, Houser and Weber, 2014), it might be argued that the capacity to override prepotent responses intended to avoid the anticipated emotional costs of being betrayed by another person is 'measured' by the CRT (Frederick, 2005). An interesting avenue for future research is to explore the mechanisms underlying the positive relation between CRT scores and trust.

REFERENCES

Aimone, J. A. and Houser, D. (2012): “What You Don’t Know Won’t Hurt You: A Laboratory Analysis of Betrayal Aversion,” *Experimental Economics*, 15(4), 571-588.

Aimone, J. A., Houser, D., and Weber, B. (2014): “Neural Signatures of Betrayal Aversion: An fMRI Study of Trust,” *Proceedings of the Royal Society B: Biological Sciences*, 281(1782), 2013-2127.

Algan Y. and P. Cahuc (2010): “Inherited Trust and Growth,” *American Economic Review*, 100(5), 2060-2092.

Arrow, K. J. (1972): “Gifts and Exchanges,” *Philosophy & Public Affairs*, *1*(4), 343-362.

Bartling, B., E. Fehr, M. Marechal, and D. Schunk (2009): “Egalitarianism and Competitiveness,” *American Economic Review*, 99(2), 93-98.

Ben-Ner, A., Kong, F., and L. Putterman (2004): “Share and Share Alike? Gender-pairing, Personality, and Cognitive Ability as Determinants of Giving,” *Journal of Economic Psychology*, 25(5), 581-589.

Berg, J., Dickhaut, J. and K. McCabe (1995): “Trust, Reciprocity, and Social History,” *Games and Economic Behavior*, 10(1), 122-142.

Bohnet, I., Greig, F., Herrmann, B. and Zeckhauser, R. (2008): “Betrayal Aversion: Evidence from Brazil, China, Oman, Switzerland, Turkey, and the United States,” *The American Economic Review*, 98(1), 294-310.

Bohnet, I., Herrmann, B. and Zeckhauser, R. (2010): “Trust and the Reference Points of Trustworthiness in Gulf and Western Countries,” *Quarterly Journal of Economics*, 125, 811-828.

Bohnet, I. and Zeckhauser, R. (2004): “Trust, Risk and Betrayal,” *Journal of Economic Behavior & Organization*, 55(4), 467-484.

Bosch-Domènech, A., P. Brañas-Garza and A. M. Espín (2014): “Can exposure to prenatal sex hormones (2D: 4D) predict cognitive reflection?” *Psychoneuroendocrinology*, 43, 1-10.

Brandstatter, H. and W. Guth (2002): “Personality in dictator and ultimatum games,” *Central European Journal of Operations Research*, 10(3), 191-215.

Brañas-Garza, P., T. García-Muñoz and R. Hernán-González (2012): “Cognitive Effort in the Beauty Contest Game,” *Journal of Economic Behavior & Organization*, 83(2), 254-260.

Brañas-Garza, P., P. Kujal and B. Lenkei (2015): “Cognitive Reflection Test: Whom, how, when,” *mimeo*.

Carl, N. and F. C. Billari (2014): “Generalized Trust and Intelligence in the United States,” *Plos One*, 9(3), 1-10.

Casari, M. and T. Cason (2009): “The Strategy Method Lowers Measured Trustworthy Behavior,” *Economics Letter*, 103(3), 157-159.

Charness, G. and M. Dufwenberg (2006): “Promises & Partnership,” *Econometrica*, 74(5), 1579-1601.

Charness, G. and M. Dufwenberg (2010): “Bare Promises: An Experiment,” *Economics Letters*, 107(2), 281-283.

Chen, C., Chiu, I, Smith, J. and T. Yamada (2013): “Too Smart To Be Selfish? Measures of Cognitive Ability, Social Preferences, and Consistency,” *Journal of Economic Behavior & Organization*, 90, 112– 122.

Corgnet, B., A.M. Espín and R. Hernan-Gonzalez (2015a): "The Cognitive Basis of Social Behavior: Cognitive Reflection Overrides Antisocial But Not Always Prosocial Motives," Economic Science Institute working papers 15-04.

Corgnet, B., R. Hernán-González, P., Kujal and D. Porter (2015b): "The Effect of Earned Versus House Money on Price Bubble Formation In Experimental Asset Markets," *Review of Finance* 19, 1455-1488.

Cosmides L, H. C. Barrett and J. Tooby (2010): "Adaptive specializations, social exchange, and the evolution of human intelligence," *Proceedings of the National Academy of Sciences*, 107(Supplement 2), 9007-9014.

Cueva, C., Iturbe-Ormaetxe, I., Mata-Perez, E., Ponti, G., Sartarelli, M., Yu, H., and V. Zhukova. (in press): "Cognitive (ir)reflection: New Experimental Evidence," forthcoming in *Journal of Behavioral and Experimental Economics*, special issue on Cognitive Abilities.

Eckel, C. C. and R. K. Wilson (2004): "Is trust a risky decision?," *Journal of Economic Behavior & Organization*, 55(4), 447-465.

Fehr, E. (2009): "On the Economics and Biology of Trust," *Journal of the European Economic Association*, 7, 235-266

Fehr, E., and K. Schmidt (1999): "A Theory of Fairness, Competition, and Cooperation," *Quarterly Journal of Economics*, 114(3), 817-868.

Fehr, E., and K. Schmidt (2006): "The Economics of Fairness, Reciprocity and Altruism – Experimental Evidence and New Theories," *Handbook of the Economics of Giving, Altruism and Reciprocity*, 1, 615-691.

Frederick, S. (2005): "Cognitive Reflection and Decision Making," *Journal of Economic Perspectives*, 19(4), 25-42.

Guiso, L., Sapienza, P., and L. Zingales (2004): "The Role of Social Capital in Financial Development," *American Economic Review*, 94(3), 526-556.

Guiso L., Sapienza P. and L. Zingales (2006): "Does Culture Affect Economic Outcomes?," *Journal of Economic Perspectives*, 20(2), 23-48.

Holt, C., and S. Laury. (2002): "Risk Aversion and Incentive Effects," *American Economic Review*, 92(5), 1644-1655.

Hooghe M., S. Marien and T. de Vroome (2012): "The cognitive basis of trust. The relation between education, cognitive ability, and generalized and political trust," *Intelligence*, 40(6), 604-613.

Houser, D., Schunk., D, and J. Winter "Distinguishing Trust From Risk: An Anatomy of ohe Investment Game," *Journal of Economic Behavior and Organization* 74(1), 72-81

Johnson, N. and A. Mislin (2011): "Trust Games: A Meta-Analysis," *Journal of Economic Psychology*, 32(5), 865-889.

Karlan, D. (2005) "Using Experimental Economics to Measure Social Capital and Predict Financial Decisions," *American Economic Review*, 95, 1688-1699

Kosfeld, M., M. Heinrichs, P.J. Zak, U. Fischbacher, and E. Fehr (2005) "Oxytocin Increases Trust in Humans," *Nature* 435, 2005, 673-676.

Millet, K., and S. Dewitte (2007). Altruistic behavior as a costly signal of general intelligence. *Journal of Research in Personality*, 41(2), pp. 316-326.

Oechssler, J., Roider, A. and P. Schmitz (2009): "Cognitive Abilities and Behavioral Biases," *Journal of Economic Behavior & Organization*, 72(1), 147-152.

Ponti G., and Rodríguez-Lara, I. (2015): “Social Preferences and Cognitive Reflection: Evidence from Dictator Game Experiment,” *Frontiers in Behavioral Neuroscience*, 9, 146.
Smith, A. (1759): Theory of Moral Sentiments, Strand & Edinburgh: A. Millar; A. Kincaid & J. Bell.
Sturgis P., S. Read and N. Allum (2010): “Does intelligence foster generalized trust? An empirical test using the UK birth cohort studies,” *Intelligence*, 38(1), 45-54.
Toplak, M., West, R. and K. Stanovich (2011): “The Cognitive Reflection Test As a Predictor of Performance on Heuristics and Biases Tasks,” *Memory and Cognition*, 39(7), 1275-1289.
Toplak, M., West, R. and K. Stanovich (2014): “Assessing miserly information processing: An expansion of the Cognitive Reflection Test,” *Thinking & Reasoning*, 20(2), 147-168.
Yamagishi, T. (2001): “Trust as a Form of Social Intelligence,” in: K. Cook (ed.), Trust in Society. Russell Sage Foundation series on trust, vol. 2., (pp. 121-147), New York.

Appendix A (Instructions)

A.1. The Charness-Dufwenberg (2006; 2010) Trust Game (Study 1)

Page 1

Welcome

Thank you for participating in this experiment. The purpose of this experiment is to study how people make decisions in a particular situation. Feel free to ask questions as they arise, by raising your hand. Please do not speak to other participants during the experiment.

Page 2

You will receive $7 for participating in this session. You may also receive additional money, depending upon the decisions made (as described below). Upon completion of the session, this additional amount will be paid to you individually and privately.

Page 3

You will be participating in a decision task where you will make a certain choice.

During the session, you will be paired with another person located in a different room.

No participant will ever know the identity of the person with whom he or she is paired.

Page 4

In each pair, one of you will have the role of Person A, and the other will have the role of Person B. The amount of money you earn depends upon the decision made in your pair.

Page 5

The Diagram

The decision making problem you will see looks similar to the one you see in the diagram.

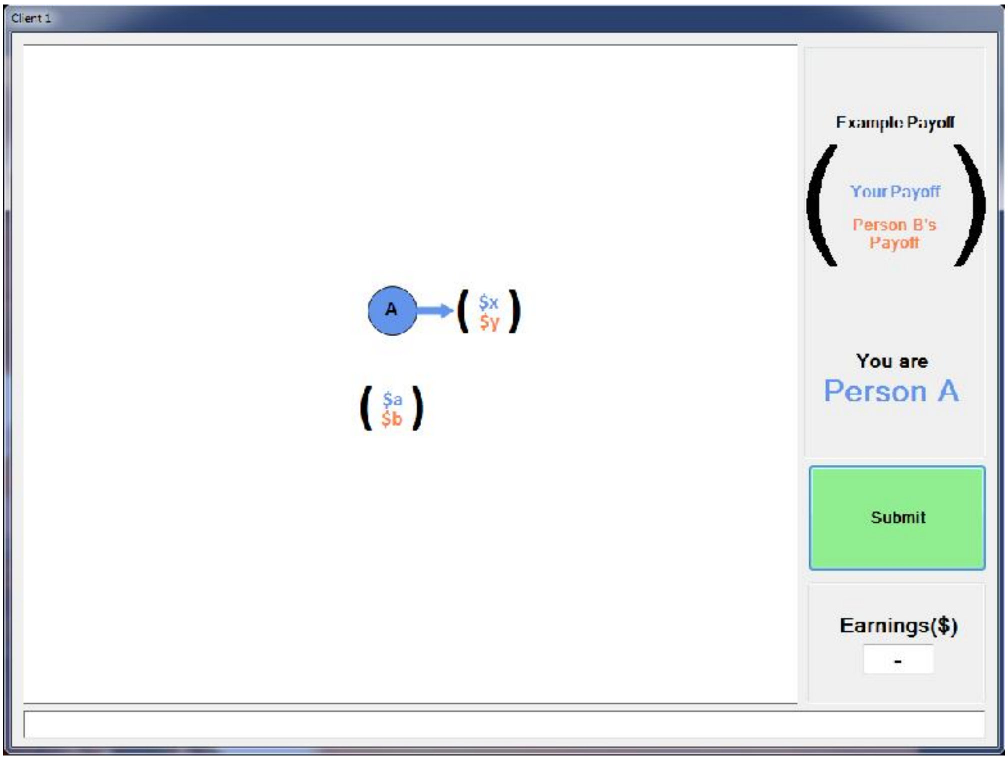
Payoffs to you and the other person will be displayed in parenthesis in the diagram. There are two numbers:

Person A will earn what is in blue, and

Person B will earn what is in orange

if that decision is made.

You and the other person will jointly determine a path through the diagram to a set of payoffs, which will be described next.



[Diagram shown to Player A]
[The blue arrow flips from one node to the other]

Page 6

The Diagram Continued

A circle in the diagram is a point at which one person makes a decision. Each circle is color coded to indicate whether Person A or Person B will be making that decision. You will always have two options. Those options will include some combination of clicking on a set of payoffs and/or clicking on a circle.

If a person chooses a circle, another person will make the next decision at the next level in the diagram.

If a set of payoffs is chosen, the round ends with each of you receiving your respective earnings.

Page 7

Example 1

Choose a payoff (by clicking on one of the payoffs in the diagram) and click the Submit button.

Page 7 (after click the Submit button)

Example 1

Choose a payoff (by clicking on one of the payoffs in the diagram) and click the Submit button.

(done)

Given your choice in this example.

Person A earns $a [$x].

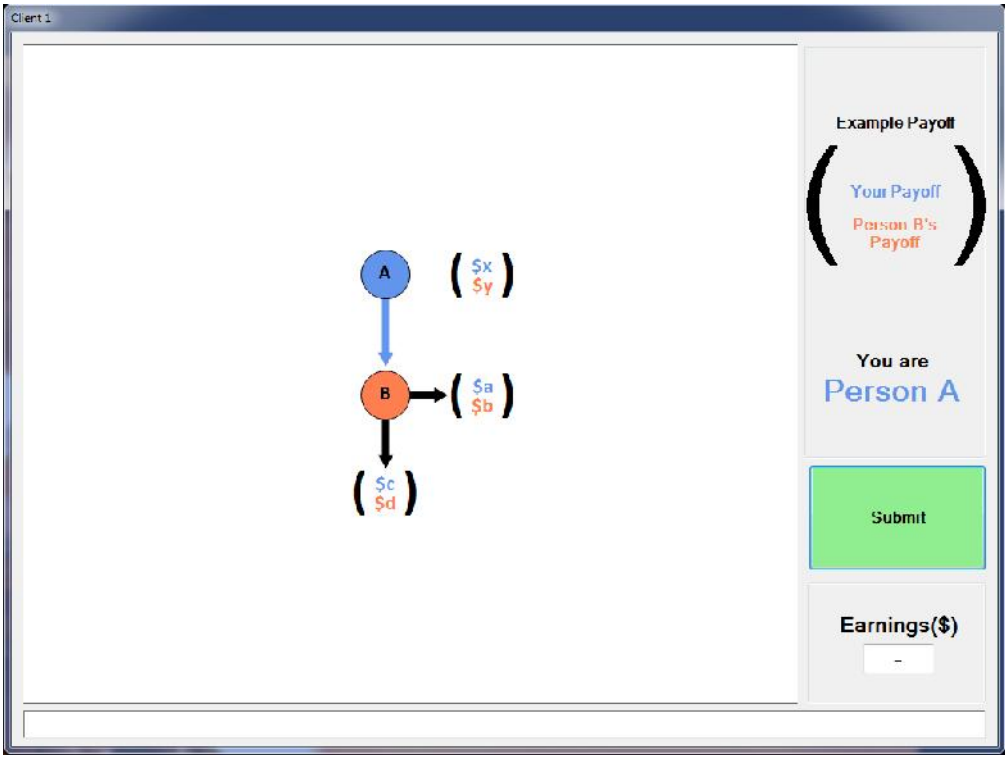
Person B earns $b [$y].

Continue to the next page of instructions.

<u>Page 8</u>

Example 2

Click on the Orange circle and press the Submit button.



[Diagram shown to Player A]
[The blue arrow flips from one node to the other]

<u>Page 8 (after click the Submit button)</u>

Example 2

Click on the Orange circle and press the Submit button. **(done)**

Person B now makes the next decision. He or she will choose a set of payoffs.

Continue to the next page of instructions.

<u>Page 9</u>

Notice that in the example below the payoffs are determined with the roll of a computerized die.

If Person A chooses **Don't** (roll a die), then A receives \$a and B receives \$b.

If Person A chooses **Roll** then a six sided die is rolled to determine the payoffs.

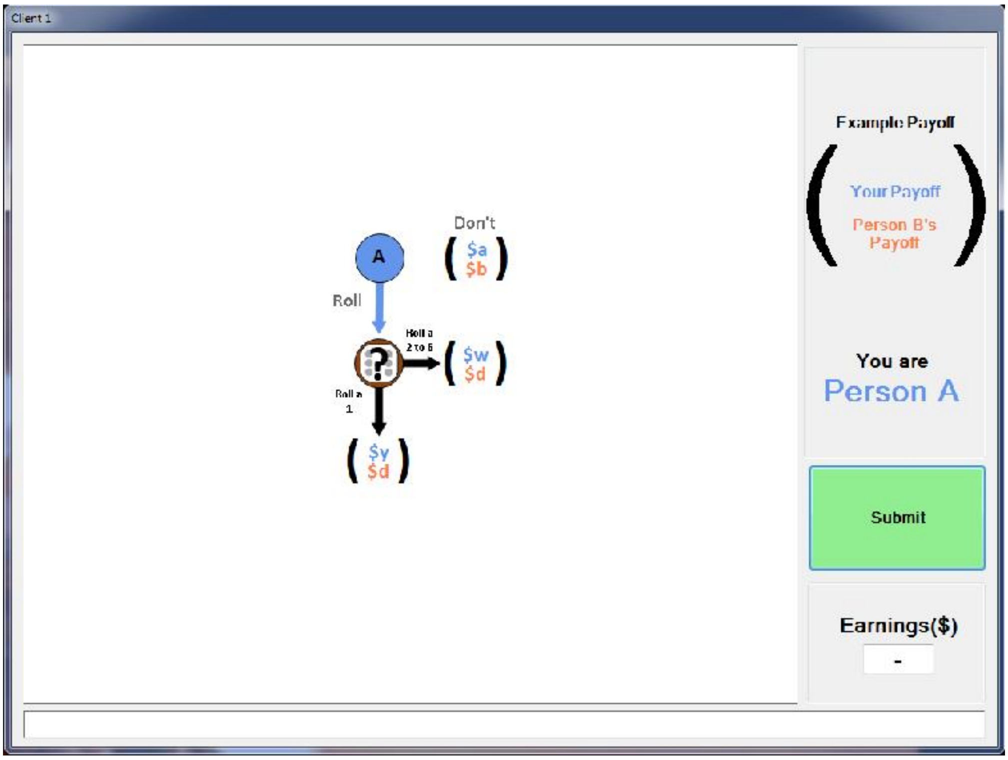
If the die comes up 1, A receives \$y and B receives \$d.

If the die comes up 2-6, A receives \$w and B receives \$d.

Notice that Person B's payoff is always \$d.

Example 3

Click on the Die and press the Submit button.



[Diagram shown to Player A]
[The blue arrow flips from one node to the other]

Page 9 (after click the Submit button)

Notice that in the example below the payoffs are determined with the roll of a computerized die.

If Person A chooses **Don't** (roll a die), then A receives \$a and B receives \$b.

If Person A chooses **Roll** then a six sided die is rolled to determine the payoffs.

If the die comes up 1, A receives \$y and B receives \$d.

If the die comes up 2-6, A receives \$w and B receives \$d.

Notice that Person B's payoff is always $d.

Example 3

Click on the Die and press the Submit button. **(done)**

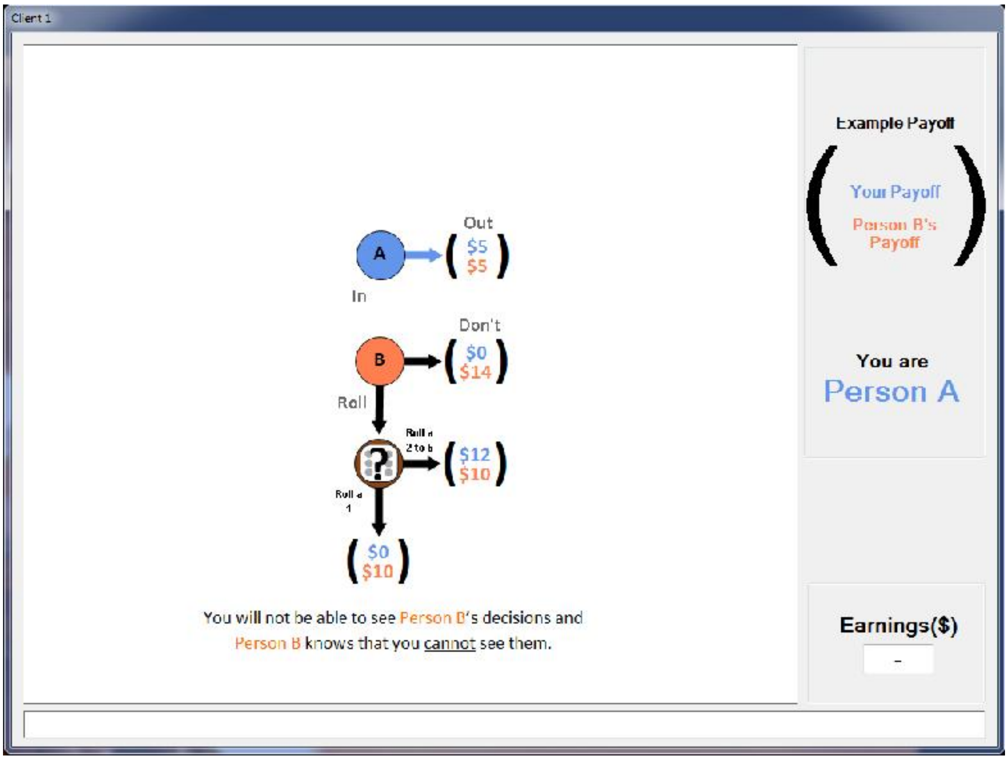
A computerized die will be rolled to determine the payoffs ($w/$d) or ($y/$d).

Continue to the next page of instructions.

Page 10

The actual decision making problem is now displayed.

Continue to the next page of instructions.



[Diagram shown to Player A]
[The blue arrow flips from one node to the other]

Page 11

The actual decision making problem is now displayed.

In this decision making problem Person A will decide first by choosing **In** or **Out**.

If Person A chooses **Out**, A and B each receive $5.

If Person A chooses **In**, then following Person A's choice, Person B will indicate whether he or she wishes to choose **Roll** or **Don't** (roll).

If A has chosen **In** and B chooses **Don't** (roll), then B receives $14 and A receives $0.

If A has chosen **In** and B chooses **Roll**, B receives $10, and rolls a six sided die to determine A's payoff.

If the die comes up 1, A receives $0.

If the die comes up 2-6, A receives $12.

Person A will NOT be able to see Person B's decisions.

Page 12

The payoff information is summarized in the chart below:

	A receives	B receives
A chooses **Out**	$5	$5
A chooses **In**, B chooses **Don't** (roll)	$0	$14
A chooses **In**, B chooses **Roll**, die = 1	$0	$10
A chooses **In**, B chooses **Roll**, die = 2,3,4,5, or 6	$12	$10

If you have any questions, please raise your hand and a monitor will come by to answer them.

If you are finished with the instructions, please click the Start button. The instructions will remain on your screen until everyone has clicked the Start button.

We need everyone to click on the Start button before the experiment can begin.

A.2. The Berg, Dickhaut and McCabe (1995) Trust Game (Study 2)

In this part you are going to be paired with another participant. Both of you will make decisions in the role of two players, S and R. Once all the decisions have been made the computer will randomly select one of you to be player S and the other person will be player R. Finally, payoffs will be computed according to the decisions made by each participant in the role randomly assigned by the computer.

Both players start with an initial endowment of $10. Then, player S has to decide whether to keep his or her $10 or pass them to player R. If player S decides to pass the $10 to player R, the $10 will be multiplied by three. In this case, player R will decide how to allocate the $30 between both players. The different options are as shown in the next screen.

	$0 for yourself and 300 for player S
	$50 for yourself and 250 for player S
	$100 for yourself and 200 for player S
	$150 for yourself and 150 for player S
	$200 for yourself and 100 for player S
	$250 for yourself and 50 for player S
	$300 for yourself and 0 for player S

Example 1: If player S chooses the option "keep the $10":

- The participant in the role of player S will receive $10 corresponding to his or her initial endowment.
- The participant in the role of player R will receive $10 corresponding to his or her initial endowment.

Example 2: If player S chooses the option "pass the $10" and player R chooses the option "$15 for yourself and $15 for player S":

- The participant in the role of player S will receive $15.
- The participant in the role of player R will receive $25, that is, $15 corresponding to the final allocation and $10 corresponding to his or her initial endowment.

A.3. Risk Aversion elicitation (Study 2)

For each line in the table in the next screen, please state whether you prefer option A or option B. Notice that there are a total of 10 lines in the table but just one line will be randomly selected for payment. Each line is equally likely to be chosen, so you should pay equal attention to the choice you make in every line. At the end of the experiment, a number between 1 and 10 will be randomly selected by the computer. This number determines which line is going to be paid.

Your earnings for the selected line depend on which option you chose in that line: option A or option B. To determine your earnings, a second number between 1 and 10 will be randomly selected by the computer. This number is then compared with the numbers in the line and option selected (see the table in the next screen):

- If you selected option A and the second number shows up in the upper row you earn $2.00. If the number shows up in the lower row you earn $1.60.
- If you selected option B and the second number shows up in the upper row you earn $3.85. If the number shows up in the lower row you earn $0.10.

To summarize, you will make ten choices: for each decision row you will have to choose between Option A and Option B. You may choose A for some decision rows and B for other rows, and you may change your decisions and make them in any order.

Line	OPTION A	OPTION B
1	1/10 of $2.00, 9/10 of $1.60	1/10 of $3.85, 9/10 of $0.10
2	2/10 of $2.00, 8/10 of $1.60	2/10 of $3.85, 8/10 of $0.10
3	3/10 of $2.00, 7/10 of $1.60	3/10 of $3.85, 7/10 of $0.10
4	4/10 of $2.00, 6/10 of $1.60	4/10 of $3.85, 6/10 of $0.10
5	5/10 of $2.00, 5/10 of $1.60	5/10 of $3.85, 5/10 of $0.10
6	6/10 of $2.00, 4/10 of $1.60	6/10 of $3.85, 4/10 of $0.10
7	7/10 of $2.00, 3/10 of $1.60	7/10 of $3.85, 3/10 of $0.10
8	8/10 of $2.00, 2/10 of $1.60	8/10 of $3.85, 2/10 of $0.10
9	9/10 of $2.00, 1/10 of $1.60	9/10 of $3.85, 1/10 of $0.10
10	10/10 of $2.00, 0/10 of $1.60	10/10 of $3.85, 0/10 of $0.10

A.4. Social preferences elicitation (Study 2)

In this part of the experiment you will be asked to make a series of choices in decision problems. For each line in the table in the next screen, please state whether you prefer option A or option B. Notice that there are a total of 4 lines in the table but just one line will be randomly selected for payment. Each line is equally likely to be chosen, so you should pay equal attention to the choice you make in every line.

Your earnings for the selected line depend on which option you chose: if you chose option A in that line, you will receive $2 and the other participant who will be matched with you will also receive $2. If you chose option B in that line, you and the other participant will receive earnings as indicated in the table for that specific line. For example, if you chose B in line 2 and this line is selected for payment, you will receive $3 and the other participant will receive $1. Similarly, if you chose B in line 3 and this line is selected for payment, you will receive $2 and the other participant will receive $4. Note that the other participant will never be informed of your personal identity and you will not be informed of the other participant's personal identity.

After all of you have made their choices the computer will select two and only two participants in the room. The decision table of the first participant will determine the payoff of the two subjects. Then the computer will randomly determine which line of the first subject decision table is going to be paid.

The remaining participants will not be rewarded for this part of the experiment.

TABLE D2. Social preferences elicitation (Bartling et al. 2009).

Decision	Option A Payoff self, Payoff other	Option B Payoff self, Payoff other
1	$2,$2	$2,$1
2	$2,$2	$3,$1
3	$2,$2	$2,$4
4	$2,$2	$3,$5